Purpose

Scientific research requires a logical progression of steps that clearly define and focus the work being done. These steps are guided by a specific question or a problem. Research is rarely linear. Instead, scientists must be flexible, creative, and willing to change strategies. Persistence is essential as there are many more failures than successes in research. These failures often result in new strategies and new questions re-focusing research.

When designing an experimental procedure there are guidelines that will help you keep a logical progression of steps. Experiments have controls which allow for comparison and help prevent incorrect conclusions being made due to inconsistent conditions impacting the data.

The following experimental design is a guideline to be used when creating experiments in the Biomedical Sciences. It is not a strict “scientific method” protocol. It is a guide to help you create logical, thoughtful and clearly defined procedures for investigative work. You are expected to follow these guidelines when designing experiments.

Use your Lab Journal for recording all experimental design work. When recording your work write the number and title of each section as shown below. Following each design step is an explanation (shown in italics), of the format that is to be used in your lab journal for that specific step. The evaluation rubric is based on following the steps of design and using the correct format to record the information in your journal.

Steps of Experimental Design

**1.      Identify the Problem or Question**

1. State the research problem or question in one sentence.
2. The problem should be very specific and measurable.

Write one sentence in the form of a question or problem statement.

**2.      Introduction**

1. Clarify the problem or question by briefly explaining the purpose of the research.
2. Explain the importance of the question or problem.

Write one or two paragraphs to clarify the problem or question.

**3.      Research and Current Ideas**

1. Explain the current status of the previous research done to address the problem or answer the question.

Write  one or two paragraphs of text, with sources identified, to explain the status of current research.

**4.      Predict a solution to the problem or an answer to the question.**

a) This will be in the form of a hypothesis.

b) This solution design or hypothesis should be based on previously obtained knowledge or research and be supported by scientific evidence.

Write a one or two-sentence statement predicting the outcome of the experiment.

**5.      Design the experiment to be used to test your hypothesis.**

1. Be specific.
2. Include safety concerns.
3. Include a list of all materials used.
4. Identify a control to be used for comparison.
5. Specify the environmental conditions that need to be consistent.
6. Clearly define how the data will be collected and recorded, including measurement units.
7. Design a data table to use to record information.
8. Plan the strategy that will be used to summarize the data. For example, a graph might be used to summarize the data.

Write a series of numbered steps and include a list of required materials as well as safety precautions that will be followed. The data table should include  units that will be used to collect data.

**6.      Carry out the experiment.**

1. Collect data.
2. Make observations.
3. Complete multiple trials. (Do the procedure many times, collecting data each time).

Complete the data table including units and labels on each section.

**7.      Analyze the data and observations.**

1. Be logical and clear.
2. Look beyond the obvious.

Write in paragraph form and include calculations showing all work. All analysis should be explained clearly and concisely.

**8.      State the conclusion.**

1. Use a one sentence statement.
2. Be clear and concise.

Write a one sentence statement directly related to the original hypothesis. It might start with “The hypothesis was correct…”

**9.      Summary Paragraph**

1. Write a brief paragraph.
2. Explain the rationale for your conclusion.
3. Clarify details.

Write a one paragraph of text explaining the rationale for the conclusion.

After step #9 there could be several options including but not limited to:

1. Changing your hypothesis.
2. Re-designing the procedure because of design flaws
3. Developing new questions based on the work in this experiment.
4. Moving on to a new or related research topic.